

# Packing Efficiency of Small Silica Particles on Large Latex Particles

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## Abstract

There are various literature examples of colloidal nanocomposites with core-shell morphologies in which small spheres comprising the shell are assembled upon a larger spherical core.<sup>1</sup> In related work, Ottewill *et al.*<sup>2</sup> calculated the number of latex spheres required to form a well-defined shell around a latex core by assuming that (i) the latex spheres within the shell layer were hexagonally close-packed and (ii) the core diameter was significantly larger than the shell thickness (hence, to a first approximation, the latex core could be assumed to be a planar surface).

Here we consider the packing of 20 nm silica spheres onto a spherical polymer latex of variable diameter. We assume that the silica spheres pack with icosahedral symmetry around the latex, introduce a *packing factor P* and hence develop an equation to calculate the number of silica particles required for monolayer coverage. Moreover, we suggest that a good experimental test for monolayer coverage is the formation of hollow silica capsules after calcination of the original polymer-silica nanocomposite particles. The silica content of the calcined nanocomposite can be determined by thermogravimetric analysis, and thus the experimental packing fraction P can be calculated and compared with that determined theoretically. In principle, this approach may allow different nanocomposite morphologies (e.g. core-shell vs. raspberry) to be differentiated.

1. Schmid, A., Fujii, S., Armes, S. P., *et al.*, *Chem. Mater.*, **2007**, *19*, 2435
2. Ottewill, R. H., Schofield, A. B., Waters, J. A., Williams, N. St. J., *Colloid Polym Sci*, **1997**, *275*, 274.